Wheel-balancing device and wheel equipped with such a balancing device

The present invention relates to balancing wheels of vehicles provided with tyres.

If it happens for some reason that the wheel of a vehicle becomes unbalanced, the best-known means for remedying this defect is to place weights on its rim at appropriately-selected points, the weight and position of which re-establish the faulty equilibrium. This technique has the particular disadvantage that the springs, which ensure the firm fitting between each weight and the rim cause permanent local scratches on the rim when they are being installed such that when it is necessary to replace the weights when a new balancing is carried out, the marks left by these springs remain visible, so that the appearance of the rim is displeasing. It should be noted that this principle is not possible for all types of rims; in fact, balancing weights are in practice arranged on the peripheral edges of the rim which ensure an excellent retention of these weights with regard to centrifugal force which means that standard weights cannot be mounted on wheels the rims of which are not provided with such edges.

Document FR-1.151.191 proposes a balancing principle capable of being used in the previously-mentioned case of rims without edges. This aims to provide a vehicle wheel-balancing device which can be easily installed, which is easily removed and which is nevertheless securely fitted without separation despite the relative high stresses to which the device can be subjected. It is proposed to encircle the balancing weight with a band attached to the rim of the wheel. It is pointed out that the belt is advantageously firmly fixed to the weight: it is preferably attached by weld points between the hasps of the belt and the rim and it is specified that this allows the device to be installed and removed several times as the weld points can be broken using a cutter or similar.

It is clear that this solution has the disadvantages outlined with regard to the attachment springs as the welding operations and then the separation by cutter inevitably leave displeasing marks. Moreover, rims which do not have edges are not generally made of weldable materials (aluminium rims, for example).

More recently, it was proposed to balance wheels by securing the weights onto the rim using an adhesive layer with which they are provided. However, the adherence of the weights proved to be unreliable for use, in particular when washing the wheels under intense pressure. Moreover, the displeasing nature was still present, above all for aluminium rims (visible lumps or adhesive fragments remaining stuck to the rim).

Document US-A-3,786,850 describes a balancing principle aimed at combining the balancing and personalization of a wheel. It was proposed to replace standard balancing weights in lead by very visible weights to which characteristic shapes are given (letters, numbers, symbols, etc.) and which are stuck to the tyre to form attractive and characteristic designs; the weights are preferably made of rubber, for example loaded with reflective particles or with decorative metallic particles to make them as visible as possible. It is not envisaged that the balancing weights could be removed as one of the aims of visible balancing weights is to discourage theft (this aim can only be achieved if all attempts to disguise the distinctive character leaves redhibitory visible traces). In fact, the choice of rubber to produce the balancing weights gives each weight a moderate mass compared to that of a balancing weight in lead which means that the forces of centrifugal origin applied to each weight are much weaker than with lead weights. On the other hand, in practice, numerous balancing weights are required to balance a wheel (it was even envisaged to exceed the total balancing weight required, and to add, on the opposite side of the wheel axle, additional characters compensating for the excess

weight); without doubt, much time is required to correctly install all the balancing weights required. This document is therefore completely incompatible with any attempt to balance a wheel quickly or to carry out this balancing in discreet fashion.

A subject of the invention is a balancing device allowing a wheel to be balanced rapidly and easily whatever the characteristics of the rim, which is advantageously adapted to resist significant mechanical stresses (centrifugal forces occurring while driving at high speed as well as stresses generated when, for example, scraping against the curb of a pavement), the presence of which can be very discreet and which leaves barely visible traces when removed for a new balancing.

To this end, the invention proposes a balancing device for a wheel comprising a balancing weight enclosed in a case the surface of which is adapted to be integral with a tyre and which is made of material having a similar colour to that of a tyre.

It also proposes a wheel comprising a rim having an axle, a tyre and balancing device comprising a balancing weight enclosed in a case the surface of which is integral with a surface of the tyre and which is made of a material having a similar colour to that of this tyre.

It can be easily understood that, as the balancing weight is attached by its case to the tyre of a wheel, the implementation of the balancing device does not depend on the characteristics of the rim. Moreover, a material of any chosen density can be used for the balancing weight, for example lead as in the previously-mentioned balancing procedure, without having to worry about its connection to the wheel; the number of balancing devices to be installed during balancing of a wheel is therefore as low as with the standard lead weights. The attachment of the balancing device to the wheel is ensured by the case the material of which can be chosen for its bonding qualities to the material of the tyre without worrying about its density; it is thus

possible to choose a material for the case which can be easily firmly fixed to the tyre, which guarantees that the attachment will resist significant stresses. The question of choosing a material for the case which is almost the same colour as the tyre does not pose any problem in this respect (it is sufficient to choose a material for the case which is almost identical to that of a tyre). It is not necessary that the pairing formed by the material chosen to constitute the balancing weight and the material chosen for the case be easily firmly physically attached to each other as the weight is enclosed in the case, and that the retention of the weight in the case can optionally be obtained without bonding by gluing or welding between these two materials. In fact, as the weight is hidden, it can be given a specific geometry allowing a good physical anchorage (by geometry) of the case, with for example cavities, grooves, ribs, cross-cut passages, etc. into which the material of the case penetrates or alternatively which can be anchored in the thickness of the case. The preparation of the surface of the case can be a glue coating such that the balancing device is easily installed by exposing the coated surface to the air and applying it to an appropriate zone of the tyre (in practice, a side). If it is necessary to change the position of the balancing devices during a subsequent balancing, it is sufficient to remove the existing devices by cutting the case between the balancing weight and the part of the case glued to the tyre; as the case is made of a material of similar colour to that of the tyre, the residual part of the case is hardly visible.

According to preferred characteristics of the invention, optionally combined:

- the weight is a lead or lead alloy or as a variant an iron alloy or as a variant a zinc-aluminium alloy, even in plastic material.

- said surface comprises a convex section, or as a variant concave, or as a variant is at least approximately a portion of a cylinder.
- the weight has an approximately rectangular section.
- the case has an approximately constant thickness.
- the case is made of a flexible material (as a variant, it is rigid), preferably rubber based.
- the case comprises sections occupying the passages passing through the weight.
- the case is glued to the surface of the weight.
- the surface is delimited by borders which define the edges.
- said surface is pre-coated with glue.
- said surface is provided with a tape the surfaces of which are coated with adhesive.
- the case is black, or as a variant white, or as a variant green.

According to preferred characteristics of the wheel according to the invention, optionally combined:

- the balancing device is arranged along the side of the tyre, close to the rim.
- the device is arranged radially between the rim and a portion of maximum width of the tyre.
- the balancing device radially runs along the inside of a side wall of the tyre.
- the balancing device radially runs along the outside of a side wall of the tyre.
- the balancing device is engaged in a groove circumferentially provided in the tyre.
- the balancing device is engaged with a groove circumferentially provided by the tyre and an edge of the rim.

Aims, characteristics and advantages of the invention emerge from the description which follows, given as a non-limiting illustrative example with reference to the attached drawings in which:

- Figure 1 is an elevation view of a wheel according to the invention,
- Figure 2 is a transverse cross-section view of the upper part of this wheel,
- Figure 3 is a transverse cross-section view of the upper part of another embodiment of a wheel according to the invention,
- Figure 4 is an elevation view of this upper part,
- Figure 5 is a transverse cross-section view of the upper part of yet another embodiment of the wheel according to the invention,
- Figure 6 is an elevation view of this upper part,
- Figure 7 is a transverse cross-section view of the upper part of a fourth embodiment of the wheel according to the invention,
- Figure 8 is an elevation view of this upper part,
- Figure 9 is a transverse cross-section view of the upper part of a fifth embodiment of the wheel according to the invention,
- Figure 10 is an elevation view of this upper part,
- Figure 11 is a longitudinal cross-section view of a first balancing device according to the invention,
- Figure 12 is a transverse cross-section view of it,
- Figure 13 is a longitudinal cross-section view of a second balancing device according to the invention,
- Figure 14 is a transverse cross-section view of it,
- Figure 15 is a longitudinal cross-section view of a third balancing device according to the invention,
- Figure 16 is a transverse cross-section view of it,
- Figure 17 is a longitudinal cross-section view of a fourth balancing device according to the invention,

- Figure 18 is a transverse cross-section view of it,

- Figure 19 is a longitudinal cross-section view of a fifth balancing device according to the invention,

- Figure 20 is a transverse cross-section view of it,

- Figure 21 is a perspective diagrammatic view of a balancing device in the process of being coated with glue,

- Figure 22 is an end view of it,

- Figure 23 is a perspective diagrammatic view of a second balancing device the front of which has been pre-coated with glue,

- Figure 24 is an end view of it,

- Figure 25 is a perspective diagrammatic view of a third balancing device provided with an adhesive tape.

Figures 1 and 2 represent a wheel 1 comprising a rim 2 adapted to turn about an axis of rotation Z-Z and a tyre 3 engaged around this rim. This tyre is of any type adapted to equip a vehicle wheel. This tyre is provided on each of its sides 3A with a balancing device 4. Indeed, it may have only one balancing device, on one side only.

Here, this device 4 is at a distance from the edge 2A of the rim on which the balancing weights are usually attached; however, it is preferably arranged radially between this rim and part 3B of the tyre which has a maximum width. This has the notable advantage of maintaining the balancing device close to the rim and to guarantee that the centrifugal forces which prevail will in part be taken up by this bulging part 3B of the tyre.

This balancing device 4 comprises essentially a balancing weight 5 and a case 6 in which the weight is enclosed and the constitutive material of which is of a colour essentially identical to that of the constitutive material of the tyre.

This balancing weight 5 can be in standard weight as currently manufactured but without its attachment spring.

what spring?

As for the case 6, it can be obtained by moulding around the balancing weight; it is preferably made of a material identical or similar to that of which the tyre of the wheel is itself made, which is favourable to a good reciprocal attachment between tyre and case; as this material is essentially the same colour as the tyre, the presence of the weight enclosed in its case is hardly visible. This small block 4 is attached by at least one of its surfaces, treated to this end, to the side of the tyre, for example by gluing. If a balancing is shown to be necessary, the operator is provided with the block described above (after he identifies the weight characteristic according to conventional balancing procedures), and applies it firmly to the desired place, directly on the side of the tyre almost at the level of the rim.

The block 4 thus fulfils its balancing function by appearing hardly visible and leaving the tyre and rim intact if it is removed.

In fact, if a new balancing becomes necessary at some stage, the operator cuts off the external part of the case concerned, using a cutting instrument, thus freeing this part at the same time as the weight which it encloses, leaving only the internal part of the block (one side) on the tyre, which remains glued to the tyre with which it blends, being of the same type and the same colour. In this case, removal of the lead is no longer displeasing as were the balancing weights attached to the rim.

Installation of the lead balancing weights on any vehicle wheel which are necessary for balancing it is thus simple and reliable (the possible choice of a material for the case independent from that of the balancing weight makes it easy to ensure a very good mechanical bond between case and tyre).

The constitutive material of the weight 5 is preferably of standard lead (lead or lead alloy) but can also be of another material such as steel, cast iron,

zinc and aluminium alloy of zamac type, ferrous or non-ferrous alloy, or even plastic (for example polypropylene, etc.).

The case has a thickness which is preferably approximately constant (for example of the order of one millimetre) such that the shape of the weight essentially determines that of the balancing device.

The geometry of weights 5 can be that of current weights.

To ensure that the block 4 fits the tyre well, this can:

- be entirely shaped as the arc of a circle to follow the round shape of the edge of the rim (Figure 1); and/or
- have a concave surface 4A, intended to run along the tyre so as to follow the round form of the side of the tyre (Figure 2).

In the example of Figures 3 and 4, the balancing device marked 14 runs along inside an edge 13A of the tyre 13 arranged radially inside the edge 12A of the rim 12; in this case, the weight 15 advantageously has a convex surface parallel to a convex surface 14A of the block running along the tyre, whilst the opposite surface (Figure 4) can be straight (in fact, the geometry of this opposite surface is of little importance). Here, there are two balancing devices arranged on the two internal edges of the tyre.

In the example of Figures 5 and 6, where each balancing device 24 is arranged radially outside a side wall 23A of the tyre 23, radially to the outside of the edge 22A of the rim 22, the weight 25 advantageously has a concave surface parallel to a concave surface 24A of the block intended to follow the convex shape of the side wall of the tyre; the geometry of the opposite surface of the weight (in Figure 6) can be as desired, for example convex or plane, in particular. Here, there are also two balancing devices of two sides of the plane of the wheel.

In the previously-mentioned examples, the balancing device is installed in an available zone of the tyre without this having necessarily been designed to receive balancing devices according to the invention.

In Figures 7 to 10, the balancing device 34 (in Figures 7 and 8) or 44 (in Figures 9 and 10) is engaged in a channel 33A or 43A of tyre 33 or 43 provided to this end, here radially to the outside of the free edge 32A or 42A of the rim 32 or 42. In Figures 7 and 8, the device 34 is a section of piping engaged wholly or partially in a circumferential groove 33A of tyre 33 and the case surrounding the balancing weight 35 is an arched section (Figure 8) which has at least one surface 34A which is highly curved (Figure 7), at least approximately in the shape of a section of a cylinder (here essentially a half-cylinder) intended to follow the internal surface of the groove 33A. In Figures 9 and 10, the device 44 is an arched section received in a channel 43A of the tyre 43 defining a groove with the edge 42A of the rim; the balancing device 44 does not occupy all the section of this groove, remaining at a distance from this edge 42A. The case 46 surrounding the weight 45 has an arched shape with a convex surface 44A intended to run along the internal side wall presented by the tyre opposite the edge 42A (as in the case of Figures 3 and 4, the internal radial section of the weight can be as desired, concave or plane, in particular). As previously, a balancing device can be provided on the internal and/or external side of the wheel, according to the location where the tyre was equipped to this end.

The case of each of these previously mentioned balancing devices can be made of various materials, in practice of plastic or polymer-type material or of rubber-like material; for example, an EPDM-type material can be used, but PVC can also be used. This case can be flexible or rigid according to the material chosen. This case is made around the weight, for example by duplicate moulding. Completely surrounding the weight with the case

means that the weight is firmly fixed to the rubber case such that it forms a block.

The cohesion of this block is sufficiently ensured by the mechanical resistance of the case which holds the weight (Figures 11 and 12), but it is obviously improved by the possible adherence obtained between the weight and the case material along their interfaces during manufacture, for example by duplicate moulding.

The cohesion of this block can be reinforced either:

- by mechanical retention or anchorage of the case through the weight with 1 passage 60 (Figures 13 and 14), 2 passages 60 (Figures 15 and 16), even several passages 60 (Figures 17 and 18) through the weight; or

- by the insertion of a gluing product 70 between weight and case (Figures 19 and 20) in order to obtain a good adherence over all the contact surface.

The colour of the constitutive material of the case is chosen to be identical to that of the tyre (black, white, green, etc.) in order to render the block practically invisible once it is installed on the tyre; it should be noted that a person skilled in the art knows how to dye plastic or rubber materials which can be used for the case without difficulty.

In practice, as with known balancing weights, the shape and transverse dimensions (in a plane of the wheel) can be fixed and the differences in weight are obtained by differences in thickness (parallel to the axis of rotation). As a variant, the procedure can be carried out in reverse, by varying the dimension of the circumference, or even by varying several dimensions.

The balancing procedure begins with the choice of a weight device capable of compensating for the imbalance determined on the wheel in question (apparatus exists for this for standard weights and can be easily provided as a function of the distance to the axis at which the balancing devices are intended to be attached onto the tyre).

The surface of the case which is intended to be firmly fixed to the tyre is advantageously treated subsequently. This treatment could merely consist of giving it the desired geometry: in practice the geometry merely follows the complementary shape of the tyre. To ensure optimal fixing, this surface is advantageously bordered by sharp borders defining edges 80; this avoids the formation of splits between the block and the tyre capable of constituting incipient cracks which can then spread into the fixing surface between the block and the tyre. As a variant, the block sections can be tapered or in the shape of lips in order to follow the length of the tyre surface (this is obtained for example by giving the block a trapezoidal section, the large base of which is intended to extend along the surface of the tyre).

One way of obtaining an optimal adhesion is to ensure that the surfaces of the tyre and the block are clean and dry:

- a preliminary scraping of the surfaces allows the rubber to be "reactivated";
- then they are cleaned with a solvent, for example heptane; a mixture of isopropyl alcohol and water can also be used, etc.
- the block can be attached to the tyre by glue (for example of cyanoacrylate type), for example that sold by LOCTITE under the reference 406.

Figures 21 and 22 show a block or balancing device 4 according to the invention in the process of being coated with the glue 85 just before being glued against the corresponding surface of a tyre. As a variant represented by Figures 23 and 24, the block 4' is pre-coated with glue during manufacture and, when it is desired to attach it to a tyre, an optional protection film is removed to expose the layer of strongly adhesive glue 90. Figures 25 and 26 describe another variation where the coating of the fixing surface of the block 4'' consisted of using a tape 95, for example coated on both surfaces with a thermoreactivatable adhesive; after removal of an

optional protection film, it is sufficient to reactivate the adhesive.

As a variant, the adhesive layer 90 or the ribbon 95 can be put in place at the last moment.

The block thus coated with glue (according to any one of the variants presented in Figures 21 to 26) is then positioned on the tyre at the desired position with an application of pressure for several seconds. The balancing procedure is then finished.

Other fixing solutions can be envisaged with, for example, local vulcanization.

As a general rule, in the examples represented, the weight and thus the balancing block have an overall possibly arched parallelepiped shape, except in the case of Figures 7 and 8. Fixing to the tyre can be done, in these cases, on a single surface (Figures 2 to 4), on two surfaces (Figures 5, 6, 9 and 10) or a highly curved surface in a plane containing the axis of rotation (Figures 7 and 8), being able to be a semi-cylindrical surface (possibly arched to follow the circumference of the tyre).

If a new balancing is required (assuming that the tyre is to be retained):

- either the previous block is left if it does not interfere with the attachment of a new block;
- or it is cut gently at the level of the glued surface.

The balancing devices according to the invention are perfectly compatible with existing tyres and can be adapted without difficulty to tyres currently in development and which are a subject of new methods of attachment to the rim (example: tyre with vertical fastening).